

ABSTRACT OF THE DISCLOSURE

[1110] In a feedback system such as a PLL, the integrating function associated with a loop filter capacitor is instead implemented digitally and is easily implemented on the same integrated circuit die as the PLL. There is no need for either an external loop filter capacitor nor for a large loop filter capacitor to be integrated on the same integrated circuit die as the PLL. In a preferred embodiment, an analog phase detector is utilized whose phase error output signal is delta-sigma modulated to encode the magnitude of the phase error using a digital (i.e., discrete-time and discrete-value) signal. This digital phase error signal is “integrated” by a digital integration block including, for example, a digital accumulator, whose output is then converted to an analog signal, optionally combined with a loop feed-forward signal, and then conveyed as a control voltage to the voltage-controlled oscillator. The equivalent “size” of the integrating capacitor function provided by the digital integration block may be varied by increasing or decreasing the bit resolution of circuits within the digital block. Consequently, an increasingly larger equivalent capacitor may be implemented by adding additional digital stages, each of which requires a small incremental integrated circuit area. The power dissipation of the digital integration block is reduced by incorporating a decimation stage to reduce the required operating frequency of the remainder of the digital integration block.